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CORRUGATOR
[Korugeta]

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Claims

1. A type of corrugator characterized by the following facts: the corrugator has the following parts: corrugating rolls for corrugating the core, an adhesive applier for applying adhesive on the corrugated crest portions of the corrugated core, a single facer that bonds the adhesive-applied core with an inner liner fed separately by means of a pressing device and a dielectric heating device, an adhesive applier for the half-corrugated sheet that applies the adhesive on the corrugated crest portions of the half-corrugated sheet obtained by bonding said core and said inner liner with said single facer, and a double facer that bonds the half-corrugated sheet with an outer liner fed separately by means of a pressing device and a dielectric heating device; and said parts are arranged around an endless belt that circulates in motion.

2. The corrugator described in Claim 1 characterized by the fact that said single facer or double facer is arranged paired with said dielectric heating device, with said endless belt sandwiched between them.

3. The corrugator described in Claim 1 characterized by the fact that said endless belt is made of an insulating material.

4. The corrugator described in Claim 1 characterized by the fact that an insulating belt, which works together with the endless belt to hold and transport said half-corrugated sheet and said outer liner, is arranged on the double facer.

Detailed explanation of the invention

[0001]

Technical field of the invention

The present invention pertains to a type of corrugator as a machine for forming corrugated paper cardboard.

[0002]

Prior art

In the following, an explanation will be given regarding the corrugator of the prior art with reference to Figure 4. Here, (1) represents a mill roll stand that feeds inner liner (4); (1') represents a mill roll stand that feeds inner liner (4'); (2) represents a mill roll stand that feeds core (5); (2') represents a mill roll stand that feeds core (5'); (3) represents a mill roll stand that feeds outer liner (6); and (3') represents a mill roll stand that feeds outer liner (6'). Usually, in order to exchange paper sheets, plural mill roll stands are arranged for each said type of mill roll stand. Figure 4 is a diagram illustrating an example in which two units are arranged for each said type of mill roll stand.

[0003]

Here, (7) represents an adhesive applicer for the core; (8) represents an adhesive applicer for the half sheet; (9) represents a single facer that bonds inner liner (4) and core (5); (11) represents a double facer that bonds outer liner (6) with half-corrugated sheet (10) prepared by bonding inner liner (4) and core (5) by means of single facer (9). On the downstream side of double facer (11), completed corrugated cardboard (12) obtained by bonding half-corrugated sheet (10) and outer liner (6) is cut by cutter (13).

[0004]

In the following, an explanation will be given in more detail regarding the manufacturing process of the corrugated cardboard. Said single facer (9) comprises a pair of corrugating rolls (14) and pressing rolls (15). The outer peripheral surface of each of corrugating rolls (14) is formed in gear shape for processing core (5) into a way shape. Since core (5) is engaged between the outer peripheral surfaces of corrugating rolls (14), core (5) is processed into a way shape.

[0005]

In said corrugating rolls (14), steam is fed to heat the engaged core (5), so that it is plastic deformed into a way shape, while the temperature rises. Said core (5) processed into a way shape has its corrugated crest portions contact the adhesive-applying roll of adhesive applier (7) for the core on the outlet side of corrugating rolls (14), so that the adhesive is applied. Then, said core (5) with adhesive applied on it is fed to pressing roll (15). Said core (5) and inner liner (4) fed separately are fed between corrugating rolls (14) and pressing roll (15). In this case, a high linear pressure is applied so that core (5) and inner liner (4) are bonded to each other to become half-corrugated sheet (10). Just as with corrugating rolls (14), steam is also fed to pressing roll (15) to heat it to the temperature needed for bonding core (5) and inner liner (4).

[0006]

For said single facer (9), a bonding system similar to pressing attachment is adopted. Said half-corrugated sheet (10) output from single facer (9) is fed to double facer (11) as the next step of operation. Because the production speed of double facer (11) is higher than the production speed of single facer (9), a device known as bridge (16) is arranged between the two members, and half-corrugated sheet (10) is temporarily stored.

[0007]

For half-corrugated sheet (10) passing through bridge (16), its corrugated crest portions (the corrugated crest portions of core (5) on the side opposite to inner liner (4)) contact the adhesive-applying roll of adhesive applier (8) for the half sheet, and adhesive is applied on them. Said half-corrugated sheet

(10) with adhesive applied on the corrugated crest portions of core (5) is sent to double facer (11). Said double facer (11) comprises plural cast heating boxes (hereinafter to be referred to as heating plates) (17) arranged side-by-side, endless cotton belt (18) suspended between two rolls (20), and plural pressing rolls (19). Steam is fed to each of heating plates (17), and outer liner (6) runs on the side of heating plates (17) between heating plates (17) and endless cotton belt (18). Said half-corrugated sheet (10) runs on the side of endless cotton belt (18), and, while outer liner (6) and half-corrugated sheet (10) are pressed by pressing rolls (19) towards heating plates (17), the corrugated crest portions (adhesive-applied corrugated crest portions) of core (5) of half-corrugated sheet (10) are bonded to outer liner (6).

[0008]

Said double facer (11) differs from said single facer (9) in that a high linear pressure is applied for bonding (adhesion), and the wavy portions of half-corrugated sheet (10) are crushed. For this reason, tens of pressing rolls (19) are arranged along the running direction and apply pressure in a manner that does not crush the wavy portions.

[0009]

Problems to be solved by the invention

Said corrugator for the prior art has the following problems.

(1) Said half-corrugated sheet (10) output from single facer (9) is fed to double facer (11) of the next step of operation. Because the production speed of said double facer (11) is higher than that of single facer (9), a device known as bridge (16) is arranged between the two members, and half-corrugated

sheet (10) is temporarily stored. (2) Although not shown in the figure, a preheater or other heating device for preheating the paper before bonding should be arranged, and the corrugator becomes longer.

[0010]

For both single facer (9) and double facer (11), instead of directly heating the adhesive, the paper sheet is heated. Since the temperature of the paper sheet is raised, the temperature of the adhesive rises indirectly. Consequently, double facer (11), which should have a lower pressure on heating plates (17) than single facer (9), has poor thermoconduction efficiency. Naturally, the corrugator should be longer. From this feature, the corrugator becomes longer.

[0011]

Also, single facer (9) and double facer (11) are arranged at positions separated from each other, and there exists the surplus sheet path of the bridge or the like between them. Consequently, after half-corrugated sheet (10) leaves single facer (9) and before it reaches double facer (11), the water content in half-corrugated sheet (10) varies. When bonding is performed by means of double facer (11), the water content differs between half-corrugated sheet (10) and outer liner (6), leading to warping and deterioration of the quality. This is undesired.

[0012]

The objective of the present invention is to solve the aforementioned problems of the prior art by providing a type of corrugator characterized by the following facts: [1] it is possible to decrease the length of the corrugator (compacter), so that it is possible to have a smaller operation range for the operator and a higher operation efficiency; [2] it can minimize the difference in water content when

paper sheets are bonded with each other, so that it can prevent warping and can improve the quality of the product.

[0013]

Means to solve the problems

In order to realize the aforementioned objective, the present invention provides a type of corrugator characterized by the following facts: the corrugator has the following parts: corrugating rolls for corrugating the core, an adhesive applier for applying adhesive on the corrugated crest portions of the corrugated core, a single facer that bonds the adhesive-applied core with an inner liner fed separately by means of a pressing device and a dielectric heating device, an adhesive applier for the half-corrugated sheet that applies the adhesive onto the corrugated crest portions of the half-corrugated sheet obtained by bonding said core and said inner liner with said single facer, and a double facer that bonds the half-corrugated sheet with an outer liner fed separately by means of a pressing device and a dielectric heating device; and said parts are arranged around an endless belt that circulates in motion (Claim 1).

[0014]

For the corrugator described in Claim 1, the following scheme may be adopted: said single facer or double facer is arranged paired with said dielectric heating device, with said endless belt sandwiched between them (Claim 2). For the corrugator described in Claim 1, said endless belt may be made of an insulating material (Claim 3).

[0015]

For the corrugator described in Claim 1, an insulating belt, which works together with the endless belt to hold and transport said half-corrugated sheet and said outer liner, may be arranged on the double facer (Claim 4).

[0016]

Embodiment of the invention

In the following, an explanation will be given regarding an embodiment of the corrugator of the present invention with reference to Figure 1. This corrugator has the following parts: corrugating rolls (14), (14) for corrugating the core, adhesive applier (7) for applying adhesive on the corrugated crest portions of corrugated core (5), single facer (9') that bonds adhesive-applied core (5) with inner liner (4) fed separately by means of pressing device (24) and dielectric heating device (23), adhesive applier (8) for the half-corrugated sheet that applies the adhesive on the corrugated crest portions of half-corrugated sheet (10) obtained by bonding said core (5) and said inner liner (4) with said single facer (9'), and double facer (11') that bonds half-corrugated sheet (10) with outer liner (6) fed separately by means of pressing device (32) and dielectric heating device (31); and said parts are arranged around endless belt (22) (insulating belt) that circulates in motion.

[0017]

Said endless belt (22) (insulating belt) is hung on rolls (21), (21), (25), (28), (28). (30) represents the endless belt (insulating belt) of double facer (11'), and said endless belt (30) is hanged on rolls (29), (29). As shown in Figure 1, single facer (9') and double facer (11') are arranged near each other and in the upper/lower portions of the series, respectively. A characteristic feature of the present invention is

that single facer (9') and double facer (11') are arranged near each other in the series. Consequently, as shown in Figure 2, when adhesive applier (33) is manufactured, single facer (9') and double facer (11') can be arranged horizontally in the series.

[0018]

In the following, the operation of the corrugator shown in Figure 1 will be explained in more detail. After core (5) is formed into a wavy shape by means of corrugating rolls (14), (14), the corrugated crest portions of core (5) contact the adhesive-applying roll of adhesive applier (7) so that the corrugated crest portions of core (5) are applied with adhesive. Said core (5) and inner liner (4) fed separately are fed by endless belt (22) (insulating belt) and between pressing device (24) of single facer (9') and dielectric heating device (23), and endless belt (22) (insulating belt) slides on dielectric heating device (23).

[0019]

In this case, due to the electric field fed from dielectric heating device (23), the adhesive applied on the corrugated crest portions of core (5) is heated. Meanwhile, by means of pressing device (24), core (5) and inner liner (4) are pressed under the minimum possible pressure to form half-corrugated sheet (10). In this case, the pressure may be 100-200 mmAq, and it may be provided as pneumatic pressure or the like. After passing single facer (9'), half-corrugated sheet (10) goes through roll (25), and it is transported by endless belt (22) (insulating belt) towards roll (28) for the operation of bonding with outer liner (6).

[0020]

In this case, the corrugated crest portions of half-corrugated sheet (10) contact the adhesive-applying roll of adhesive applier (8), so that adhesive is applied on the corrugated crest portions of half-corrugated sheet (10). Said half-corrugated sheet (10) is then transported by endless belt (22) (insulating belt) together with outer liner (6) that is fed separately. They enter between pressing device (32) and dielectric heating device (31) of double facer (11'), and endless belt (22) slides on endless belt (22) (insulating belt).

[0021]

The pressing device (32) and dielectric heating device (31) of double facer (11') used are the same types as those of pressing device (24) and dielectric heating device (23) in single facer (9'). It is preferred that endless belt (22) (insulating belt) and endless belt (30) (insulating belt) be made of Teflon, fiberglass belt or other insulating material having low dielectric constant and dielectric loss coefficient. Examples of the dielectric heating devices that may be used include one having flat plate type electrodes or grid electrodes and working at frequency of 10-30 MHz, and one using microwave at frequency of 2,450 MHz represented by microwave oven. It is well known that the adhesive can be heated by means of dielectric heating at a rate several orders of magnitude higher than that of paper. As a result, only the adhesive is selectively heated. For the double facer portion, the length of the equipment can be shortened to about 1/2-1/3 that of the prior art. Consequently, when the same equipment length is adopted, it is possible to increase the operation speed. Also, when the same production rate is adopted, it is possible to have more compact equipment.

[0022]

Also, the single facer and double facer, each having a dielectric heating device and a pressing device, are arranged immediately preceding and immediately after the adhesive applier. As a result, for the same quantity of adhesive applied on the half-corrugated sheet, in theory, the two have the same heating length. As a result, the difference in the operation speed, as would take place in the prior art, can be eliminated, and the difference in speed can be absorbed. Consequently, bridge (16) is not needed. By selectively heating the adhesive as aforementioned, the preheater (not shown in the figure) for preheating of the paper sheet itself is not needed. As a result, the length of the equipment also can be reduced significantly.

[0023]

In addition, in the corrugator of the prior art, the half-corrugated sheet output from the single facer is transported by said bridge, etc., before arriving at the double facer. During this period, the water content of the half-corrugated sheet varies continuously, and, when it is bonded with the outer liner by the double facer, the difference in water content that occurs between the two members causes warping. On the other hand, for the corrugator of the present invention, a dielectric heating device is adopted. In this dielectric heating device, heating is concentrated only on the adhesive portion, while little heating is performed on the paper sheet, which depends significantly on variation in the water content. Consequently, it is possible to minimize the difference in water content when the paper members are bonded, and it is thus possible to prevent warping.

[0024]

Figure 3(a) is a diagram illustrating the corrugator in the prior art. Figure 3(b) is a diagram illustrating the corrugator of the present invention. For the corrugator of the present invention, both the single facer and the double facer can be shortened. For the corrugator of the present invention, the weight of the double facer can be reduced with respect to that of the double facer of the corrugator in the prior art (double facer made of cast heating plate with high weight arranged in the series). Consequently, the corrugator of the present invention may have a 3-story building structure, and the length of the corrugator can be further decreased (compacted).

[0025]

In this case, the paper feeding part is installed on the first floor, the single facer portion is installed on the second floor, and the double facer is installed on the third floor. In this configuration, the length of the corrugator can be shortened (compacted). The operation range of the operator can be made smaller, and the operation efficiency can be increased.

[0026]

Effects of the invention

The present invention provides a type of corrugator characterized by the following facts: the corrugator has the following parts: corrugating rolls for corrugating the core, an adhesive applier for applying adhesive on the corrugated crest portions of the corrugated core, a single facer that bonds the adhesive-applied core with an inner liner fed separately by means of a pressing device and a dielectric heating device, an adhesive applier for the half-corrugated sheet that applies the adhesive on the corrugated crest portions of the half-corrugated sheet obtained by bonding said core and said inner liner

with said single facer, and a double facer that bonds the half-corrugated sheet with an outer liner fed separately by means of a pressing device and a dielectric heating device; and said parts are arranged around an endless belt that circulates in motion. Consequently, for example, the paper feeding part is installed on the first floor, the single facer portion is installed on the second floor, and the double facer is installed on the third floor. In this configuration, the length of the corrugator can be shortened (compacter). The operation range of the operator can be made smaller, and the operation efficiency can be increased.

[0027]

Also, for the corrugator of the present invention, a dielectric heating device is adopted in the heating devices of the single facer and the double facer. With said dielectric heating device, heating can be concentrated in only the adhesive portion, while the paper, which depends significantly on variation in the water content, is heated minimally. Consequently, it is possible to minimize the difference in water content when the paper members are bonded, and it is possible to prevent warping and to improve the quality of the product.

Brief description of the figures

Figure 1 is a side view illustrating an embodiment of the corrugator of the present invention.

Figure 2 is a side view illustrating another embodiment of the corrugator of the present invention.

Figure 3: (a) is a diagram illustrating the length of the corrugator of the prior art, and (b) is a diagram illustrating the length of the corrugator of the present invention.

Figure 4 is a side view illustrating the corrugator of the prior art.

Explanation of symbols

- 4 Inner liner
- 5 Core
- 6 Outer liner
- 7 Adhesive applier for core
- 8 Adhesive applier for half-corrugated sheet
- 9' Single facer
- 10 Half-corrugated sheet
- 11' Double facer
- 14, 14 Corrugating roll
- 22 Endless belt
- 23 Dielectric heating device of single facer (9')
- 24 Pressing device of single facer (9')
- 30 Insulating belt of double facer (11')
- 31 Dielectric heating device of double facer (11')
- 32 Pressing device of double facer (11')

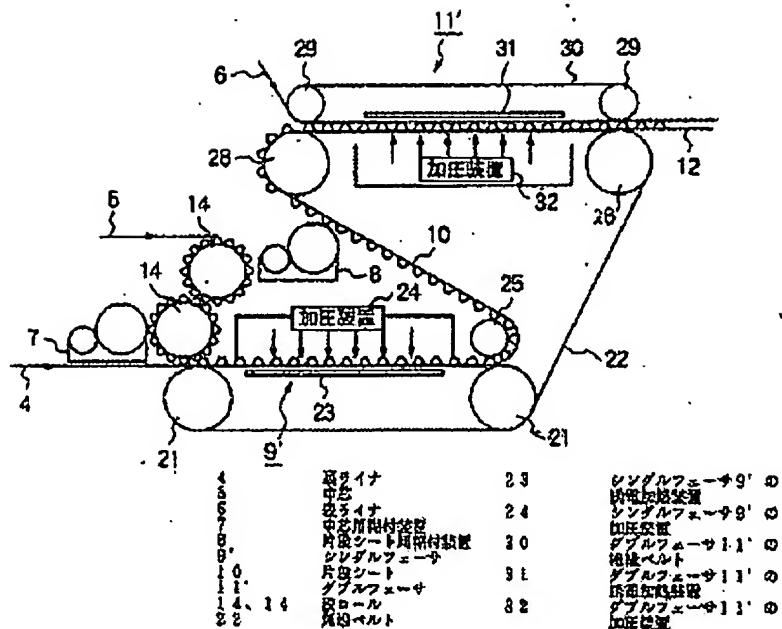


Figure 1

Legend: 4 Inner liner

5 Core

6 Outer liner

7 Adhesive applier for core

8 Adhesive applier for half-corrugated sheet

9' Single facer

10 Half-corrugated sheet

11' Double facer

14, 14 Corrugating roll

22 Endless belt

23 Dielectric heating device of single facer (9')

24 Pressing device of single facer (9')

- 30 Insulating belt of double facer (11')
- 31 Dielectric heating device of double facer (11')
- 32 Pressing device of double facer (11')

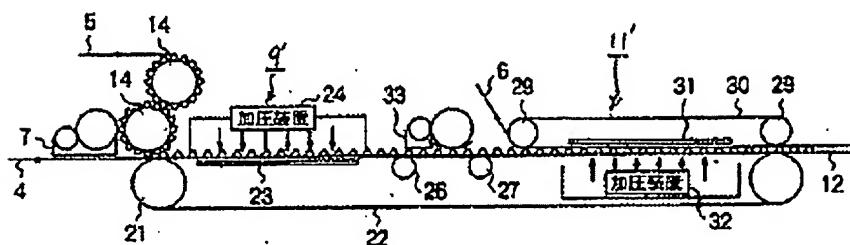


Figure 2

Key: 24 Pressing device

32 Pressing device

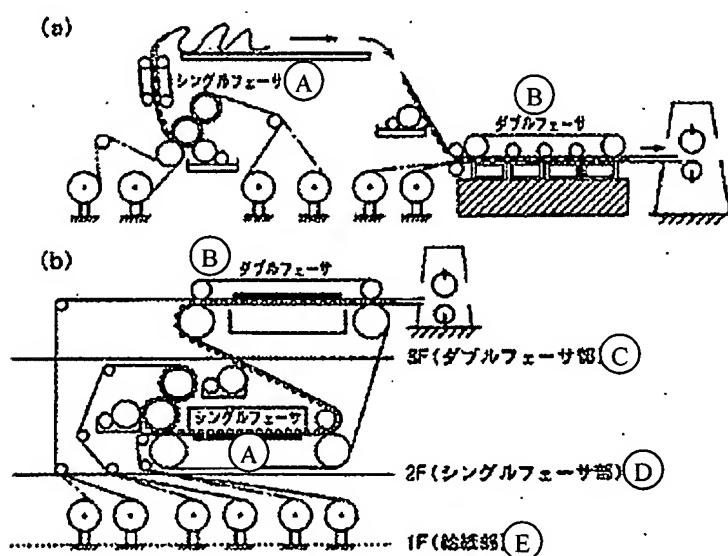


Figure 3

- Key:
- A Single facer
 - B Double facer
 - C 3F (Double facer portion)
 - D 2F (Single facer portion)
 - E 1F (Paper feeding portion)

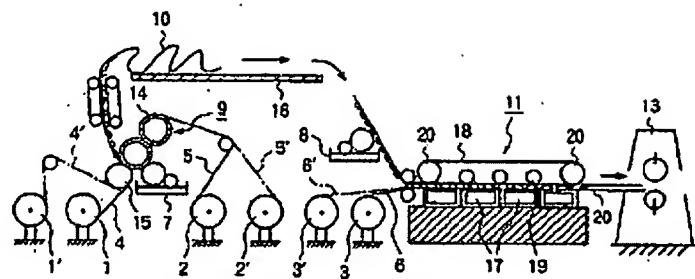


Figure 4